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WILLIAM HUGGINS, ESQ., F.R.S., President, in the Chair.

Capt. James Waterhouse, Surveyor General's Office, Calcutta,

was balloted for and duly elected a Fellow of the Society.

Note on Prof. Langley's Paper on the Direct Effect of Sun-spots on Terrestrial Climates. By W. Mattieu Williams, Esq.

Prof. Langley determines quantitatively the effects respectively produced by the radiations from the solar spots, penumbra, and photosphere upon the face of a thermopile, and infers that these effects measure their relative influence on terrestrial climate.

In thus assuming that the heat communicated to the thermopile measures the solar contribution to terrestrial climate, Prof. Langley omits an important factor, viz. the amount of heat absorbed in traversing the Earth's atmosphere; and in measuring the relative efficiency of the spots, penumbra, and photosphere, he has not taken into account the variations of diathermancy of the intervening atmospheric matter, which are due to the variations in the source of heat.

Speaking generally, it may be affirmed that the radiations of obscure heat are more largely absorbed by the gases and vapours of our atmosphere than those of luminous heat, and the great differences in the mere luminosity of the spots, penumbra, and photosphere justify the assumption that the radiations of a sun-spot will (to use the expressive simile of Tyndall) lose far more by atmospheric sifting than will those from the photosphere.

But the spot areas will be none the less effective on terrestrial climate on that account. A given amount of heat arrested by the Earth's atmosphere will have even greater climatic efficiency than if received upon its solid surface, inasmuch as the gases are worse radiators than the rocks, and will therefore, *cæteris paribus*, retain a larger proportion of the heat they receive.

I have long ago endeavoured to show * that the depth of the photosphere, from the solar surface inwards, is limited by dissociation; that the materials of the Sun within the photosphere exist in a dissociated, elementary condition; that at the photosphere they are, for the most part, combined. This view has since been adopted by many eminent solar physicists, and if correct, demands a much higher temperature within the depths revealed by that withdrawal of the photospheric veil which constitutes a sun-spot.

If I am right in this, and also in supposing the spot-radiations to be so much more abundantly absorbed than those of the photosphere, that in spite of the higher temperature of the spots, the *surface* of the earth receives from them the lower degree of heat measured by Prof. Langley, another interesting consequence must follow. The excess of spot-heat directly absorbed by the atmosphere, and mainly by the water dissolved or suspended in its upper regions, must be especially effective in dissipating clouds and checking or modifying their formation. The meteorological results of this may be important, and are worthy of careful study.

In thus venturing to question some of Prof. Langley's inferences I am far from underrating the interest and importance of his researches. On the contrary, I regard the quantitative results he has obtained as especially valuable and opportune, in affording means of testing the above-named and other speculations in solar physics. Similar observations repeated at different elevations would decide, so far as the lower regions of our atmosphere are concerned, whether or not there is any difference in the quantity of heat imparted by the bright and obscure portions of the Sun to our atmosphere. If the differences already observed by Prof. Langley vary in ascending, a new means will be afforded of studying the constitution of the interior of the Sun and its relations to the photosphere. Direct evidence of selective absorption by our atmosphere may thus be obtained, which would go far towards solving one of the crucial solar problems, viz. whether the darker regions are hotter or cooler than the photosphere.

The obscure radiations from the Moon must be absorbed by our atmosphere like those from the sun-spot, and may be sufficently effective to account for the alleged dissipation of clouds by the full moon.

In both cases the climatic influence is greatly heightened by the fact, that all the heat thus absorbed is directly effective in raising the temperature of the air. The action of the absorbed heat in reference to cloud-formation is directly opposite to that of the transmitted solar heat, which by evaporation of surface water supplies additional cloud material, instead of effecting its dissolution.

* *The Fuel of the Sun*, chapters 4 to 10.